



THE SYMPATHETIC NERVOUS SYSTEM.

BY W. F. METCALF, M. D., DETROIT, MICHIGAN.

I HAVE some cases to report, but before doing so, with your permission I wish to present the picture we have to-day of the Sympathetic System.

Two cords, one on each side of the spinal column, containing at intervals ganglia, which receive branches from both anterior and posterior roots of the spinal cord, and are connected with the cranial nerves. These cords connect plexuses, which lie along the spinal column, similar plexuses being continued to accompany the vascular trunks becoming smaller and smaller, until the periphery being reached they are microscopic. Small ganglia are found at the decussation of the fibres in these plexuses.

By the newer methods of examination, there are found in the plexuses of the intestines, the walls of the arteries, and in the stroma of glandular organs, small cells giving off processes that ramify again and again, and end by free extremities among the muscular and epithelial elements, each cell always giving off a long process which enters into the formation of the interganglionic cord. These cells apparently resemble in character those which collect impressions from the retinal rods and cones, and from the mucous membrane of the auditory passage.

Now, leaving this picture of the sympathetic system as a whole, let me call your attention to some of its parts.

(1) Continuations of the cervical plexus accompany the vessels which enter the cranium.

(2) There are fibres arising from each of the cervical ganglia, and sometimes one from the first thoracic ganglion, uniting with branches of the pneumogastric and extending to form an intricate plexus around the base of the heart, and under the arch of the aorta. From this plexus fibres pass along the coronary arteries, the descending aorta, and to the pulmonary arteries, uniting with the pulmonary plexus. Many microscopic ganglia are found on the fibres which pierce the heart muscle, and are apparently the controlling agency in its action, which explains the heart's pulsating after being removed from the body.

(3) The greater splanchnic is formed by branches derived from the sixth, seventh, eighth, and ninth thoracic ganglia, the lesser splanchnic from the tenth, eleventh, and twelfth thoracic ganglia. The root from the twelfth is sometimes independent, and is known as the renal splanchnic. Occasionally a splanchnic is formed from the first thoracic, or from the cardiac plexus. From this irregularity in formation we may infer irregularity in distribution, which may explain some clinical phenomena.

These splanchnics pass through the diaphragm and join the largest plexus of the system, the solar plexus or the abdominal brain, containing the largest ganglia. Off-shoots from this plexus accompany the vessels which supply the abdominal viscera.

One of the terminal plexuses of this division lies between the muscular layers of the intestines and of the stomach, the plexus myentericus externus, which probably controls peristalsis. In the submucosum is found the plexus myentericus internus, which controls the calibre of the small vessels, and the muscular fibres of the mucous membrane, and therefore controls secretion.

The solar plexus being continued downward along the abdominal aorta is over the last lumbar vertebra, known as the hypogastric plexus, and over the sacrum as the inferior hypogastric plexus, which is extended along the internal iliac artery.

These lower plexuses abound in minute ganglia, and are intimately connected with the genito-urinary organs and rectum, an off-shoot from the inferior accompanying the uterine and vaginal vessels.

At the fundus of the vagina surrounding the cervix uteri a ganglionic mass is found. From this is derived all the nerves which supply the lower portion of the uterus. They form plexuses within its mass between its muscular layers but no ganglia are found there.

When a sympathetic nerve is cut, the vessels to which it conveys tone—the life force—dilate, when the peripheral end is stimulated the vessels which it supplies contract.

I wish you to concede to me, gentlemen, that there is only one force in the universe, and the privilege to call your attention to a theory, thinking that by the efforts to prove it untrue, we may arrive at a simple method of translating various pathological phenomena. I act upon this theory because it pays.

There is a force, known only by its effects, which as manifested in the holding of material things in relation to common centers, is called gravity; in maintaining the animal or vegetable creation, is called life; in man's relating himself to his fellow, and to his environment, is known as mind; as it travels along the wire, manifesting itself when it meets resistance, we call it electricity.

In this paper I am dealing only with that phase of the force called life, which passes along the fibres of the sympathetic system in the human body, and which governs the caliber of the arteries, the action of the heart and lungs, and excretion of the waste products. This force manifests itself in the individual first when the spermatozoon comes in contact with the ovum, in sequentation, differentiation and development. It governs all the organic functions until dissolution or death. We would be unconscious of the presence of electricity in the wire were it not for some resistance to, or break in, the circuit. Man would have a feeling of physical well-being, all his parts would work in harmony, were there no irritation to his sympathetic system, over which the force, life, flows.

Health is a condition of equilibrium of the force functioning as life, and as mind, and of the two related. Disease is a disturbance of this equilibrium. This thought is the logical outgrowth of the idea of the physical organism, which, as other organisms, must have a law governing it. To give credit to all those who have developed the different phases which made possible the observance of this law would require a volume, and we will leave that to the historian.

Disturbances to the mind may cause it to leave its natural channels and pass into and disturb the sympathetic centers, or disturbances to the force, life, may cause it to pass out of its natural paths to enter and disturb the cerebro-spinal centres, and therefore the function or movement of the mind.

Thus, we have tears produced by an emotion, or by a cinder in the eye. We find perspiration produced by mental exertion, or by the passing of a catheter into a sensitive urethra.

We may thus explain the failure of a remedy to cure a diarrhea or a dyspepsia in cases subjected to commercial disaster, disappointment in love, or unfortunate domestic relations.

The pathway of the mind is the cerebro-spinal nerve. Its central office the brain, which controls every action. There cannot be diseases of the mind, any more than there can be diseases of life, light, gravity, electricity, affinity, love, but this force in any of its functions may be disturbed by a defect in its circuit. The pathway of life is the sympathetic nerve fibre, its central office the solar plexus. A cerebro-spinal system is not essential to organic life, and depends directly upon the sympathetic for its nutrition. In man the cerebro-spinal system has to do with the procuring of food, but the sympathetic takes care of it after it enters the esophagus.

Afferent sympathetic fibres convey from the different tissues to the sympathetic centres intelligence of their condition; the efferent fibres control the calibre of their blood-vessels, and therefore their nutrition. Messages from many or all of the tissues demanding nourishment overflow the sympathetic centres into the cerebro-spinal and are recorded in the cerebrum as hunger, a condition which the cerebro-spinal seeks to remedy.

If colloid degeneration or miliary sclerosis or other pathological changes in the cerebrum produce primary dementia, why may we not, in a case of a pathological solar plexus, have insanity of action in the organs of the human body, controlled by this force, life? If we have rupture of blood-vessels in the cerebrum under circumstances of great excitement, when the brain is most active in receiving messages, and making great effort to order and transmit them, why may we not find apoplexy of the abdominal brain, when messages are overflowing it, especially when it has already been over-worked for months.

To report cases relating to the preceding facts and deductions would require more time than is allowed me. I therefore shall report but one case and a few others, which tend to prove its translation.

Case I.—Mrs. H., aged thirty-nine years, came to my office November 14, 1893, complaining of pruritus vulvæ. Her pulse was rapid and complexion sallow. She said that she frequently suffered from headache.

Examination showed irritated labia, also a tumor of the anterior uterine wall. I ordered hot antiseptic douches and told her to return in a few days. I was called to see her December 1, found her having intense pain in the pelvis, the uterus with its tumor being fixed between and pressing upon the pubes and sacrum, the tumor having increased markedly in size since the first examination, two weeks previously. I advised consultation with a view to operation. She was removed to the Woman's Hospital, where on December 7, Doctor LONG-YEAR removed the uterus with a soft myoma in its anterior wall. After the abdomen was opened, and the organ lifted from the pelvis, incision was made across at the upper part of the cervix uteri, the sutures in the stump serving as ligatures to the vessels. A drainage tube was passed through the vaginal vault, in the posterior cul-de-sac, and the abdominal wound closed. The operation was expeditiously, neatly and well done.

Under chloroform the pulse improved. A few hours after the operation a pain shot across the upper part of the abdomen, indicating the receipt of a message in the plexus myentericus externus, causing contraction. In a few hours the pain ceased and tympanitis began in the upper part of the abdomen, indicating the absence of tone or life-force, due to paralyses of the terminal ganglia. The tongue became dry and heavily coated with a deposit of bile-pigment, perhaps owing to the ganglia of the liver failing to coördinate the messages which were rushing in upon them. Vomiting or contraction of the muscular stomach walls caused by stimuli reaching the ganglia between its coats, was an early symptom. At first the vomitus was simply mucus, then either because of the current overpowering the ganglia in the submucosum or because of the incompetent solar plexus, the vessels in the stomach lining became dilated, red blood corpuscles exuded through their paralyzed wall, and the vomitus became black.

Irritating enemata caused the passage of some gas and fecal matter, yet the upper part of the abdomen remained distended. The passage of the stomach tube showed that the gas was not in the stomach. Post-mortem showed it to be in the transverse colon. The substances injected influenced only the local ganglia, the abdominal brain having apparently lost the power of being influenced. There was therefore contraction only of the coats of the descending colon. Hypodermic injections of digitalin and nitro-glycerine had little or no effect upon the heart's action, tending to show that the centres had no communication with the peripheral stations. There was slight elevation of temperature. We suspected peritonitis. She died about fifty-four hours after the operation. Autopsy showed no peritonitis, no sepsis, stump appeared healthy. There had been no hemorrhage, but we found an ecchymotic condition of the solar plexus. Circumstances would not permit the examination of the other plexuses.

What would be the rational treatment of such a condition? Perhaps all efforts would have been futile. It may have been a fatal apoplexy, but until autopsy reveals the fact we cannot know but that it is simply a temporary functional disturbance. It may be that we should go to the station where the confusing messages are being started, to prevent their being sent. It may be necessary to cut this station off from the general system. But in this particular case where did the murderous irritation originate? I have already referred to the mass of ganglionic tissues surrounding the upper part of the cervix uteri. Through this tissue the ligatures were passed. Perhaps this ganglionic mass should have been dissected out, or perhaps when untoward symptoms appeared, the stitches should have been cut. But this proposed treatment is apparently founded upon a supposition. Permit me to report other cases tending to show this, the source of irritation.

Case II.—January 27, 1891, I operated upon MRS. A., aged thirty-seven years, for epithelioma of the uterus, removing the organ with its appendages per vaginam, using twisted silk as ligatures, and doubtless constricting some of this tissue in question. There was no hemorrhage, no symptoms of peritonitis, kidneys and bowels acted naturally, highest temperature 99.5, no chills. The heart suddenly failed on the fifth day. Stimulants hypodermically had apparently no effect upon its action. No autopsy was permitted.

Case III.—In operation for lacerated cervix, January 1, 1891, the cicatrix on the side extended downward from the internal os, and outward to the vaginal

attachment. The stitch which approximated the tissues, after the cicatricial mass was dissected out, caused constant pain in the back, and rapid pulse until it was removed on the seventh day.

Case IV.—MRS. S., June 16, 1891. Vaginal hysterectomy for cancer of the uterus. Used clamps. There followed moderate fever, some tympanitis and rapid heart action. I applied the cold water-coil to the abdomen. On the fifth day after operation when all the symptoms were favorable she suddenly collapsed, pulse at the wrist disappeared and the respiration became labored. I ordered hot water-coil over the solar plexus and digitalin, strychnine, and small doses of morphine, hypodermically. She recovered after a tedious illness.

Case V.—MRS. B., about September 15, 1893. Vaginal hysterectomy, at the Detroit Sanitarium. I wish to report this case more fully as it presents a point of special interest.

About a year previous to this operation she had an ovarian tumor removed. The other ovary and tube were so bound down by inflammatory adhesions, that the operator did not think it wise to attempt its removal, since the operation had already been a tedious one. Following this operation the pain in her head and back and across her abdomen continued; her malnutrition was marked. I found the endometrium degenerated and the cervix presenting the appearance of epithelioma. Guided by the fact that one ovary was gone, and the other was probably useless, I decided to remove the uterus. I did so without ligating a single vessel by dissecting beneath its areolar covering. I then endeavored to remove the remaining ovary, but it was fixed so high and the pelvis was so narrow that I failed. No clamps, forceps, or ligatures were used. The patient had no shock, pain, fever, nor increase in pulse-rate, and was taken home six days after the operation, where she was kept in bed ten days. That inflamed ovary is still in the abdomen, yet she says she is perfectly well. She had been constipated for fifteen years. Her bowels now move regularly. Nothing was done to the rectum. I burned the pathological part, the physiological is here. I will have her brought in that you may see a picture of good health. She has gained twenty-one pounds since the operation. She is apparently as feminine and shows as much affection for her people and for children as she did when she had pelvic organs. I attributed success in this case to the fact that no nerve tissue was ligated.

In contrast to this case, let me report briefly :

Case VI.—MRS. M., at Sanitarium, November 9, 1893. I endeavored to remove uterus by same method as in Case V. The uterus being large and very vascular, the dissection was tedious, as it was difficult to follow the surface of the uterine tissue. I entered the abdomen anteriorly and posteriorly and dissected up along the sides about four inches. Upon passing my hand into the abdomen posteriorly, I found very strong adhesions about two inches long, binding the fundus uteri to the promontory and crest of the sacrum, subinvolution being marked. These bands were formed after the removal, last March, of large abscesses, the pus of which lay in contact with both sides of the organ. I thought it unwise to dissect further, and therefore amputated the organ at the upper part of its cavity. While dissecting, I had accidentally opened the uterine artery on each side, and left a pair of forceps on each.

About twenty-four hours after the operation, the nurse telephoned that the

patient's pulse was 160, and temperature 103.8. As soon as possible I put her upon the table and removed the forceps, which were locked upon some of the tissues in question, douched in large quantities of hot water, gave digitalin hypodermically, and whisky per stomach, returned her to bed, and placed the hot water-coil over the solar plexus. In five hours her temperature was 102.6, and pulse 150. Twenty-four hours later temperature was the same and pulse 126. Five days later temperature was 101, pulse 110. During the next week the pulse and temperature became normal. There were no symptoms of peritonitis or sepsis at any time. While dressing the wound I found when I touched the tissue which had covered the upper part of the cervix, the patient would invariably complain of violent pain in the back.

Case VII.—MRS. L. I removed the uterus, ovaries and tubes February 2, 1894, per vaginam. No ligatures, forceps or clamps were used. Highest temperature, 99.6; lowest, 97.3. Highest pulse-rate, 128; lowest, 72 (pulse-rate during the week preceding operation, 100–126). Patient sat up at end of first week, and left the Sanitarium on February 15. It is now one month since operation. I will have her brought that you may see that she is well.

With limited opportunities for observation, I cannot hope to establish any fact, but I wish to elicit a general discussion of the subject.

The point at which the irritation originates may be in the stomach, the colon, in the bronchial mucous membrane explaining the profuse sweating and diarrhea of lobular pneumonia, explaining the extreme exhaustion following the grippe, in which case the irritating impulses may start from the whole mucous surface, overflowing the sympathetic ganglia into the cerebro-spinal centres. It may temporarily throw out of function the sympathetic centres, causing profuse outbursts of perspiration and in some cases complete prostration, or collapse. In short the irritation may originate in any part of the body, or in its environment, in the mind or in the social conditions which are a part of the mind.

The first effect of the transmission of messages from a pathological tissue to a distant tissue, is a constriction of the capillaries in that distant tissue followed by their dilatation, and hence congestion results, thus in mumps when the irritation is transferred from the salivary glands, to the testicles, we have swelling of the testicles with usually a subsidence of the swelling in the neck. When the swelling disappears suddenly from the neck, we find a profound general disturbance of the system sometimes collapse from the irritation passing to the peripheral ganglia everywhere. As the central ganglia in a measure get them under control, they pass out to the glandular tissue and swelling begins in the testicles or mammae, and the general symptoms disappear.

It may be that the condition of the nutrition of a tissue determines the lodgement of these reflected irritations. Thus, the symptoms of a chronic arthritis subside with the onset of acute bronchitis.

One of the results of sympathetic irritation is mal-nutrition. It may be of the whole body, or of a part of the body distant from the point of irritation. Thus an ovarian tumor may cause an eczema of the nose. A nasal polypus or an internal hemorrhoid may produce asthma. Endometritis may produce cold hands and cold feet.

Various insects are found in illy nourished plants, varying in kind according to the tissue upon which they feed. Bacilli of varied species according to the

tissue which they select as pabulum, are found in human beings, whose capillary circulation is defective. To this thought we may be compelled to turn for the successful treatment of tuberculosis.

As the rods and cones of the optic nerve receive impressions which, through that phase of the force called mind, controls the action of the cells of the social body, so the rods and cones of the sympathetic nerve may receive impressions which go to control the action of some one or all of the cells of the physical body.

DISCUSSION OF PAPER.

DOCTOR LONGYEAR: I wish that the neurologist had been called on first to discuss this subject as my own ideas on the same are somewhat indefinite. I think that as a Society we are indebted to DOCTOR METCALF; we are accustomed to consider the sympathetic nervous system in an indefinite way and it is well to consider the question in a definite way as the doctor has done. The case in which I was particularly interested was the first one which the doctor cited. The problem of there existing an affection of the nervous system was considered before the operation; the rapid pulse being a symptom which was referred to this condition. I hoped that removal of the tumor and the consequent relief from the pressure would better the condition of the nervous system. The pulse improved under the anesthetic but became worse after the completion of the operation. It seems to me that the point about the connection between the sympathetic nervous system and the cervix uteri is a very important one. It is not alone in surgical cases that we see affections of the sympathetic nervous system; they are to be seen in the actions of certain drugs. In a case of laparotomy at Harper Hospital two years ago, morphine acted very badly. After the operation, as the patient was in considerable pain, one-tenth grain of morphine was given hypodermically. This was followed by weakness of the pulse. The condition was supposed to be due to shock and stimulus was administered. The pain still continuing, the dose of morphine was repeated. This was followed the second time by circulatory disturbances. Under appropriate treatment the patient rallied and ultimately entirely recovered. The peculiar effect of the drug in this case might be due, in my opinion, to a peculiarity of the make-up of the sympathetic system. I hope that the points which DOCTOR METCALF has made in his paper can be worked out to the practical benefit of the members of the profession.

DOCTOR HITCHCOCK: While not wishing to quibble over the matter, I must take issue with the doctor's thesis that there is only one force in nature, and that as there are no diseases of electricity, there can be no diseases of mind. However, granting for the sake of argument the truth of the statement of DOCTOR METCALF in this question, what is the benefit therapeutically, or what real advance have we made? I had hoped that the doctor would have given us some suggestions in the line of treatment.

DOCTOR EMERSON: I must congratulate the essayist of the evening for the thought and originality displayed. I have been much interested, not only on account of the cases recounted but also because his theory coincides with a theory of my own formulated from clinical observation. The theory is that the sympathetic system is a subsidiary system allied most closely to the cerebro-

spinal system. The connection between the two systems is a most intimate one. The distribution of the sympathetic system is as wide as possible and its functions are as wide as its distribution. It might be compared to the commissary system in the army. Wherever the army goes, there goes the commissary. Unless the commissary is maintained, the army is helpless. I believe that the cerebro-spinal system is, if I may be allowed the use of the expression, the originating part of the nervous system, where the vital impulses are generated. The sympathetic system acts as a coördinate and regulating part. In hearing the paper this evening I was reminded of the pamphlet published some years ago by DOCTOR BUCK on the "Sympathetic Nervous System." In that treatise the author advances the theory formed by a process of exclusion and negation that the sympathetic system has to do solely with the emotional part of our nature. There are certain grounds for this conclusion. Certain emotions are very markedly controlled by the action of the sympathetic system. It is a matter of some surprise to me to note how little space our leading text-books devote to this subject.

DOCTOR MINER: I have learned to be very deferential to the sympathetic nervous system during the last few years of my practice. The action of certain drugs upon the nervous system is the basis of homeopathy. In this, our brothers of the opposite faith have been very far-sighted. Most of the remedial agents used by the homeopaths have a selective action on the sympathetic nervous system. The mucous membranes of the respiratory organs are supplied with capillaries governed by vaso-motor nerves. Congestion may occur as the result of vaso-motor paresis. We have the clinical observations that cases of asthma, hay fever, chronic rhinitis, et cetera, are caused by chronic irritation of the sympathetic nervous system with the consequent influence on the vaso-motor nerves. Many of the cases are to be treated by general tonics. Asthma has been caused by a laceration of the cervix uteri where an operation on the cervix was successful in removing the respiratory trouble. I believe that congestion of these membranes may be caused by irritations from any part of the body. It is well known that nasal polypi may cause asthma. I have seen at least twenty-five cases where the removal of a polypus from the nose has cured the asthma. Ovarian irritation has caused talipes where surgical measures for the ovary have removed the foot trouble. In the next ten or fifteen years, in all probability, the sympathetic nervous system with its disorders and treatment will be classed as a speciality.

DOCTOR SAMPSON: I think that this is the most important paper which I have heard read before this Society. I am astonished to find that some of the members know as little about the subject as I do. In connection with this subject I have been most interested in a paper recently published detailing the reports of six or eight cases of progressive neuritis. The cases steadily grew worse and death came very suddenly in each one. Careful dissections of the lesions showed that the neuritis passed along to the spinal centres with involvement of the splanchnics which govern the heart. There is no doubt that there is no field in the domain of medicine which offers richer returns for scientific investigation than does the sympathetic nervous system.

DOCTOR IVES: The only point which I can offer on this subject is to propound the inquiry which has so often suggested itself to my mind. Why the sympathetic nervous system is without the covering which we find about the nerve

fibres of the other nervous system? It may be that the white substance of Schwann is an extra insulation which is not needed for the sympathetic system.

DOCTOR METCALF: Perhaps the patient DOCTOR LONGYEAR refers to was at the time in a condition bordering upon shock and the additional depressing effects of the one-tenth grain of morphine upon the terminal ganglia caused a general dilatation of the blood vessels, thus reducing blood pressure, accounting for the peculiar action of the heart. In answer to DOCTOR HITCHCOCK I may say that my endeavor has been to read unity into the functions of the nerve systems. The parts of any science are developed independently of each other but they are only fully understood when we have the full development of the science. By way of illustration, take a simple example in addition: two and three are five; "two and three" has no meaning until the value of "five" is comprehended. The tool of unity is necessary to the translation of cases. It is indispensable to me. The theory was not founded upon the cases reported, but upon numerous and varied cases; upon my experience for years; these cases being selected because the original idea of the paper was to report the case operated upon by DOCTOR LONGYEAR. I would like to know DOCTOR EMERSON's reason for thinking that the force originates in the cerebro-spinal system. In referring to DOCTOR BUCK's article mentioned by DOCTOR EMERSON in which he (DOCTOR BUCK) speaks of the sympathetic as the system of the emotions, I wish to say that I understand emotion to be a term applied to the mind when it is out of motion or incapable of moving round to will or definite related action; but the cerebro-spinal system is primarily involved in every movement of the mind. Of course, when the mind is out of motion or has lost direction it may overflow into the centres of the sympathetic system and cause blushing, changed heart action (as occurred on Seventeenth Street last week when a lady died instantly upon the receipt of bad news), diarrhea, micturition and various other manifestations of a disturbed sympathetic or life force; while on the other hand an irritation to the sympathetic may overflow into the cerebro-spinal channels thereby becoming an obstruction to the mind and resulting in the production of emotion. The sympathetic nerve fibre is not exposed to the frictions which endanger the cerebro-spinal fibres; they, therefore, do not need the protection of the primitive sheath. I thank DOCTOR MINER for his remarks which go to support the thought I have endeavored to express. I do not, however, agree with him that further study of the sympathetic nervous system will tend to diminish the use of surgical measures. I am convinced that it will increase the frequency of surgical procedure. I thank DOCTOR SAMPSON for his, it may be flattering, though encouraging, remarks. If this is a dream as the doctor calls it, it is a day dream and has influenced my practice for several years.

